

Voice Outcome in Patients Treated for Laryngeal Cancer: Efficacy of Voice Rehabilitation

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Summary: Objective. To investigate the efficacy of voice rehabilitation regarding acoustically measured voice quality as well as self-perceived function after radiotherapy for laryngeal cancer.

Study Design. Prospective intervention study.

Methods. Twenty male patients irradiated for laryngeal cancer participated in the study. Voice recordings and self-assessment of voice function (hoarseness, vocal fatigue, and vocal loudness) were made one and 6 months after completion of radiotherapy. The recordings were analyzed with the program *Praat*. Ten of the patients received 10 sessions of structured voice rehabilitations between the recordings and 10 worked as a control group.

Results. Jitter and shimmer improved for both groups. Harmonics-to-noise-ratio and maximum phonation time improved for the patients who received voice rehabilitation while it deteriorated for the control group. The self-assessment questions about vocal fatigue and vocal loudness showed improvement for both groups while hoarseness showed no change.

Conclusion. General improvement was seen for both the study group and the control group. Despite the lack of statistical significant difference, there are trends where greater improvement in perturbation and self-assessment measures are noted in the study group. The results suggest positive effects of voice rehabilitation in both voice quality and self-perceived function.

Key Words: Voice training–Laryngeal neoplasms–Voice quality–Acoustics–Radiotherapy.

INTRODUCTION

In Sweden, laryngeal cancer has an incidence of about 200 new cases a year.¹ Almost 80% of the cancer patients are men and most patients are diagnosed in the age between 50 and 85 years. The prognosis for laryngeal cancer depends on tumor localization, tumor size, and possible presence of metastases. Discovered in an early stage, glottic cancer can be treated quite successfully by either radiotherapy ± chemotherapy or surgery.

The voice quality is affected after radiotherapy and although several studies suggest some spontaneous improvement of voice quality after radiotherapy, a return to normal function does not occur.^{2–7} A recent review of the literature on voice outcomes after radiotherapy found that most studies only focus on one dimension of the voice, often the patient's experience through patient-reported outcome (PRO) because no particular equipment or experienced clinicians are needed to analyze the outcomes.⁸ Further studies analyzing voice outcomes with a multidimensional approach including PRO, acoustical, and perceptual analysis are required. A changed vocal quality affects not only the audible vocal sound connected to a person's identity but also influences on the functional and psychological aspects of vocal communication that for many patients lead to a disrupted social life.⁹

Speech-language pathologists (SLPs) are specialized in communication disorders. They possess an in-depth knowledge of the anatomical and neurophysiological aspects of the normal and abnormal voice and have a multitude of voice and compensatory and rehabilitative techniques to improve a damaged voice. However, only a few studies have examined the outcome of voice therapy in irradiated laryngeal cancer patients.^{4,10–12} Van Gogh et al¹¹ studied 23 patients after radiotherapy where 12 patients received voice therapy and 11 functioned as a control group. The results indicate that voice rehabilitation is effective, both in terms of acoustical analysis and how the patients experience their voices.^{11,12} Evidence of the efficacy of voice therapy after radiotherapy for laryngeal cancer is, however, limited. This study aims to further investigate whether the voice improves after voice rehabilitation in terms of acoustical and temporal analysis and PROs.

MATERIALS AND METHODS

Patients and controls

Male patients, from the western part of Sweden (Västra Götaland county), with stages T1–T3 glottic and supraglottic cancer treated with irradiation formed the study population (Table 1). Inclusion criteria were that the patient had to have good cognitive abilities, speak fluent Swedish, and be able to complete questionnaires. Patients who received surgical excision of the tumor were excluded from the study. The patients were included into a study group (n = 10) who received voice rehabilitation with an SLP or into a control group (n = 10).

Design

The design of the study consisted of an assessment battery 1 and 6 months after the oncology treatment cessation. The assessment battery included voice recordings and questions about

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TABLE 1.
Sociodemographic and Clinical Characteristics in the Study Group and the Control Group

Characteristics	Study Group (n = 10)	Control Group (n = 10)
Age (y), n (range)	59 (38–79)	53 (35–67)
Radiation dose, n (range)	64.5 Gy (62.4–68)	63.2 Gy (62.4–64.6)
Tumor site, n (%)		
Glottic	7 (70)	8 (80)
Supraglottic	3 (30)	2 (20)
T-stage, n (%)		
T1	7 (70)	4 (40)
T2	2 (20)	4 (40)
T3	1 (10)	2 (20)
Smoking habits, n (%)		
Nonsmoker	5 (50)	5 (50)
Smoker	3 (30)	3 (30)
Quit smoking >12 months ago	2 (20)	2 (20)
Comorbidity (ACE-27), n (%)		
None	6 (60)	5 (50)
Mild	2 (20)	4 (40)
Moderate	2 (20)	1 (10)
Severe	0 (0)	0 (0)

Abbreviations: ACE-27, Adult Comorbidity Evaluation-27; Gy, gray.

voice and communication. Between the two assessments, voice rehabilitation was undertaken by the study group.

Voice rehabilitation. The voice rehabilitation was conducted according to a structured protocol (Table 2) at the hospital nearest to the patient's home in the Västra Götaland county and started approximately 1 month after completion of oncologic treatment. Voice rehabilitation was given by two trained SLPs in the research group. The protocol was specified according to Swedish standard voice training¹³ and made in consensus in the research group before the study started. It included 10 specified voice rehabilitation sessions of 30 minutes each, spread over 10 weeks, and consisted of relaxation, respiration, posture,

and phonation exercises. Table 2 describes the rehabilitation sessions. The patients were asked to follow-up with voice training at home between the sessions. The control group did not receive any voice rehabilitation but were followed with recordings and self-assessment of voice in parallel with the study group. The control group received vocal hygiene advice.

Voice recordings. The recordings were made in a sound-proof booth with a Panasonic Professional Digital Audio Tape Recorder SV-3800 (Panasonic Nordic AB, Kurva, Sweden) at a sampling frequency of 44.1 kHz. A headset microphone (Sennheiser MKE 2-p, Sennheiser Nordic, Solna, Sweden) was used at a measured distance of 12 cm from the corner of

TABLE 2.
Specification of the Voice Rehabilitation Sessions

Session Number	Specification of the Sessions
1	Basic exercises: relaxation, posture, and breathing. Focus to find abdominal activity in breathing and unvoiced fricatives. Description of voice physiology. Starting with phonation.
2	Repetition of first session, phonation to a greater extent; voiced sounds and syllables.
3	Repeat basic exercises, expand with repeated syllables, short words. Begin generalization with short phrases.
4	Repeat and expand on session 3. Intonation and stressed syllables introduced.
5	Phonation with simultaneous physical movement. Longer phrases.
6	Repetition of most patient-relevant techniques. Focus on words and phrases of different lengths with resonance. Articulation exercises to find relaxed articulation.
7	Using learned techniques in reading of dialogs and conversation. Focus on appropriate pausing, eye contact.
8	Repetition of most patient-relevant techniques. Focus on volume and voice projection.
9	Repetition of most patient-relevant techniques.
10	Repetition of most patient-relevant techniques.

The sessions took place two times/week during the first 2 weeks, once a week during weeks 3–6, and once every second week during the last 2 weeks, a total of 10 sessions. Home exercises occurred after every session with a focus on the techniques taught.

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